After descriptions of the various kinds of cathodes and of their physical properties—notably their electrical properties—have been given, and after the processes occurring in them have been discussed, the treatise concludes with a listing of 334 patents that were examined in preparing the material. (In this listing, the patents of The General Electric Company Ltd, and of the General Electric Company are combined. If this is an oversight, it is the first this reviewer has noticed in any volume of Gmelin.)

The *Lithium* volume shows how short a step it is from nuclear physics to inorganic chemistry. In part because nuclear physics has made lithium isotopes important, the demand for the metal has grown, and the space devoted to its preparation and technology in this supplementary volume (pp. 126–142) had to be greatly increased over what sufficed in the parent volume (pp. 18–20), which was issued in 1927. Further, the new volume warns us (pp. 136 and 156) that the lithium salts now on the market are radically reduced in ^{6}Li content. The section on physical properties (pp. 143–199) will repay inspection by any physicist interested in what Gmelin has to offer him. He will find there in minimum space all the information available prior to 1950 on all the physical properties of lithium, and many references to work by scientists such as Bethe, Born, Coulson, Heisenberg, Kapitza, Saha, Sommerfeld, H. A. Wilson, Zener, and Zworykin.

No one is immune to poisoning by mercury. Nowhere is one likely to find a more complete, concise, and comprehensive summary of this important problem than on pp. 169–180 of the *Mercury* volume. The most impressive demonstration of its importance occurred at sea on "The Triumph" in 1810. Liquid mercury spread through the ship, and 200 persons suffered acute poisoning within 3 weeks. Two of these died after losing all their teeth, and none of the animals on board survived.

The present *Oxygen* volume, the fourth devoted to this element in the Eighth Edition, treats air, active oxygen, and ozone. It is unusual in that it is actually closer to physics than to chemistry. This situation arises because only the mechanical properties of air needed treatment here, and because active oxygen and ozone are so closely associated with electrical and photochemical processes.

Gmelin has been anticipating the space age by the comprehensive way in which the occurrence of elements is discussed. The *Strontium* volume begins with the occurrence of the element in the stars and their atmospheres, goes on to its cosmic abundance, next to its occurrence in meteorites, and then settles down to treat its complex geochemistry. Britain continues to be the main source of supply—is this not a unique situation? The grim current significance of one strontium isotope enhances the value of the information in Gmelin on strontium in the biosphere and on its behavior there relative to that of calcium.

Sulfur has had a Part A (3 volumes) to itself alone, and the present volume (758 pages) is the second section of Part B, Part B being devoted to its compounds. Note that this section deals only with one family (the oxo-acids) among the acids of sulfur, and that the description of sulfurous acid alone necessitated working over some 5000 original publications. The physicist can gain from this volume an inkling of the volume of information that forms the chemist's stock in trade. The physicist may be pardoned a feeling of relief that this important volume is of little direct concern to him.

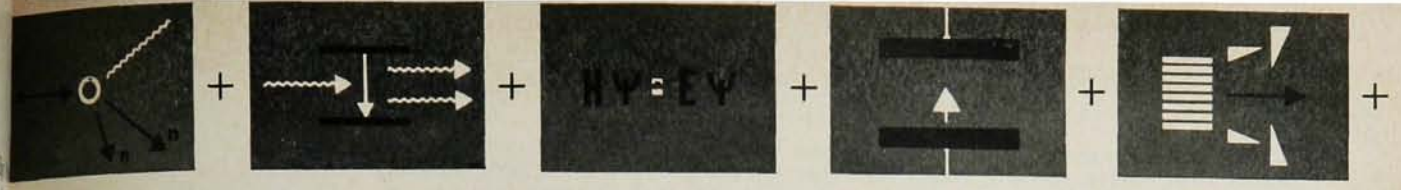
On March 4, 1961, West Germany increased the value of the mark by 5%. On the next day, the dollar prices of the Gmelin volumes increased by 5%. They continue to be worth what they cost.

Time and the Physical World. By Richard Schlegel. 211 pp. Michigan State U. Press, East Lansing, Mich., 1961. $7.50. *Reviewed by R. B. Lindsay, Brown University.*

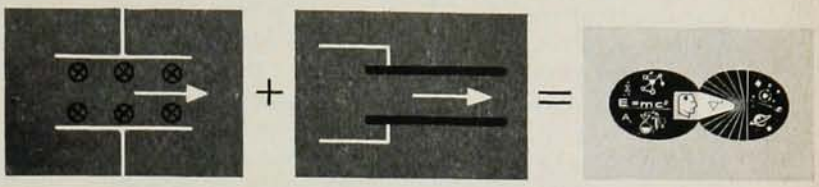
"WHAT, then, is time? If no one asks of me, I know. If I wish to explain it to him who asks, I know not." So St. Augustine is supposed to have delivered himself on this mysterious mode of grouping sense impressions. His perplexity about the subject, though shared by many, has not prevented philosophers and scientists through the ages from succumbing to its fascination and writing voluminously to try to convince themselves and others that they really understand the nature of the concept. Professor Schlegel's book is one of many recent attempts to come to grips with the subject.

It should be stated at the outset that the chief interest in this book lies not so much in the presentation of the more or less standard review of the nature of the concept of time as used in physics, as in a certain ingenious point of view of the author with respect to the relativistic interpretation of time. He distinguishes between what he calls Lorentz processes and Clausius processes. The former are those in which a physical system is in interaction with an observer, as for example, an electron whose mass while in motion the observer is attempting to measure. These are the systems to which he would have the Lorentz transformation equations apply. On the other hand, there are processes which do not obviously involve interaction with an observer, or so the author implies. An example would be the internal physical process which makes a clock go. To this he would not apply the Lorentz relativistic transformation equations. Here apparently a careful distinction must be made. The *reading* of a clock by an observer involves direct interaction and is therefore subject to the transformation equations, but the *internal* processes in the clock are not so subject. In general, in the author's view, macroscopic thermodynamic processes are time-invariant; whence the appropriateness of attaching the name Clausius to them.

There will doubtless be some argument about the value of this speculative hypothesis, but, as the author points out, it does have one interesting consequence. If it is accepted, the so-called "clock paradox" will disappear. It will be recalled that this refers to the twins,



Physics Research at ALLISON



• These familiar symbols, representing broad areas of investigation at Allison, add up to our guiding theme, "Energy Conversion Is Our Business."

Long-range objective of Allison scientific investigation is the creation and development of practical energy conversion devices for such applications as direct nuclear conversion systems . . . plasma acceleration for space flight propulsion . . . energy depots and other forms of energy conversion systems.

An immediate objective centers on the Military Compact Reactor (MCR). Allison has been selected by the Atomic Energy Commission to design and develop MCR—a highly mobile, completely self-contained nuclear fission power system—to provide electric power in remote areas.

To implement these expanding and long-range programs, we need additional scientists and engineers—both theoretical and experimental:

NUCLEAR PHYSICISTS—(Shielding)—Ph.D. or M.S. or equivalent, with capabilities in nuclear reactor shielding field, including experience in experimental shielding investigations and associated minimum weight shield configurations.

(Reactor)—Ph.D. or M.S. or equivalent with substantial experience in reactor physics field to analyze nuclear behavior of projected reactors; generate new concepts in design or control of nuclear reactors.

(Experimental)—Ph.D. preferably in nuclear physics, or equivalent with experience in experimental nuclear physics, to plan, conduct and analyze critical experiments on compact reactor core configurations.

SOLID STATE PHYSICISTS—(Section Chief)—Ph.D., 5-10 yrs. experience in experimental solid state physics to direct group of scientists in experimental research on materials of interest in direct energy conversion.

(Senior Research)—Ph.D. in theoretical physics. Energy conversion experience desirable. Will carry out theoretical work on the thermodynamics and physics of energy conversion devices. Considerable use will be made of computing systems (analog and digital). Radiant energy conversion, thermionic, liquid metal systems will be analyzed initially.

(Research)—Ph.D. Must be capable of carrying out independent research in property evaluation of semiconductors and metals. Some attention also to liquid state physics. Radiant energy conversion devices emphasized in early work.

MATHEMATICAL PHYSICISTS—Ph.D. or M.S. in mathematics, or equivalent. Prefer experience in reactor analysis and programming for digital and analog computer. Must be capable of carrying out all computer operations (digital or analog) required by nuclear engineering.

M.S. in mathematics with courses in nuclear physics. Requires strong analytical training in field of mathematics with experience in nuclear reactor field.

THERMIONIC RESEARCH PHYSICISTS—Ph.D. with established reputation in field of thermionic energy conversion, or thermionic emission. As group leader, he must provide technical leadership in all areas related to development of practical thermionic converters (nuclear, solar, and chemical heat sources).

M.S. or Ph.D. preferred to direct work in planning and performing experiments on test diode configurations. Requires strong academic background in theoretical and experimental plasma physics with emphasis on gas discharges, plasma dynamics, diagnostic techniques and thermionic emission.

Ph.D. or equivalent (solid state physics)—Requires good knowledge of solid state physics associated with high temperature materials used in thermionic converters. Will require study of new materials and/or new processes for emitter and collector electrodes in a thermionic converter.

PLASMA PHYSICISTS—(MHD Power Generation Research)—Ph.D. in physics or engineering. Must be well-versed in theory of plasmas and gaseous discharges. Will be required to lead a research and development program in field of MHD power generation.

(Propulsion)—Ph.D. in physics or engineering. Must be well-versed in plasma physics and experienced in application of important diagnostic methods such as probes, spectroscopy, and microwaves. Will lead an established research program in pulsed plasma propulsion.

(Basic Research)—Ph.D. in physics or mathematics. Background should include vector and tensor analyses, fundamentals of probability theory, fundamentals of classical mechanics and electrodynamics, the kinetic theory of plasmas, and the principles of magnetohydrodynamics. Will conduct theoretical studies in support of experiments in a low density plasma tunnel.

Openings available NOW. A promising future for those who qualify is available in in the creative environment at Allison—plus all the opportunities and advantages offered through an organization with the character of General Motors. Interested? Let us hear from you. Send your resume or write to: Mr. V. A. Rhodes, Professional and Scientific Placement, Dept. 511, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

An equal opportunity employer

ALLISON DIVISION, GENERAL MOTORS CORPORATION

one of whom stays on earth, while the other cruises in a spaceship with speed approaching that of light. The conclusion of special relativity theory is that when the space traveler returns to earth he will find his brother much older in years than he is. Though there has been controversy over this deduction, it is now generally admitted to be a valid consequence of the theory. According to Schlegel's view, however, the moving clock will not actually run slow and the space traveler will gain no advantage so far as aging is concerned over his earth-bound brother. This may make some people happy! At any rate the author's point deserves careful consideration.

In the opinion of the reviewer, the weakness of the book lies in the introductory treatment of the nature of time. In his attempt to disregard so-called psychological time in order to concentrate on what he calls "physical" time, the author appears to commit the fallacy of supposing that the two can really be separated in any logical discussion. The introduction of the concept "cyclical" in the attempt to provide a "physical" definition of time leads to circular reasoning. The author is not content with, nor does he mention, the pragmatic notion of time in physics as a simple parameter serving as a useful independent variable to relate the behavior of different physical systems and whose range of variation is the real-number continuum. The interesting views of Poincaré on this matter are ignored. There are many loosely phrased and misleading statements in the discussion of the relation between time and the statistical behavior of thermodynamic systems, notably with respect to the H-theorem and entropy.

The writer's style is rather repetitious and diffuse. In spite of these shortcomings, however, the book has numerous suggestive ideas and may be read with profit.

BOOKS RECEIVED

Introduction to Atomic and Nuclear Physics (4th ed.). By Henry Semat. 628 pp. Holt, Rinehart & Winston, New York, 1962. $7.50.

Introduction to Nuclear Physics and Chemistry. By Bernard G. Harvey. 370 pp. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1962. $12.00.

Nuclear Electronics. Conf. Proc. (Belgrade, May 1961). Vol. 1, 597 pp., $11.00; vol. 2, 459 pp., $8.00. IAEA, Vienna, 1962. Distr. in US by Internat'l Publications, Inc., New York. Both paperbound.

Magnetogasdynamics and Plasma Dynamics. By Shih-I Pai. 197 pp. (Springer-Verlag, Vienna) Prentice-Hall, Inc., Englewood Cliffs, N. J., 1962. $14.00.

Collected Papers. Vol. 1, Italy, 1921–1938. By Enrico Fermi. 1043 pp. (Accademia Nazionale Dei Lincei, Rome) University of Chicago Press, Chicago, 1962. $15.00.

Atomic-Absorption Spectrophotometry. By W. T. Elwell and J. A. F. Gidley. 102 pp. The Macmillan Co., New York, 1962. $5.00.

Rock-Forming Minerals. By W. A. Deer, R. A. Howie, J. Zussman. 333 pp. John Wiley & Sons, Inc., New York, 1962. $15.50.

Theory of Molecular Excitons. By A. S. Davydov. Transl. from Russian by Michael Kasha and Max Oppenheimer, Jr. 174 pp. McGraw-Hill Book Co., Inc., New York, 1962. $7.95.

Proceedings of the Rutherford Jubilee International Conference, Manchester 1961. J. B. Birks, ed. 856 pp. Academic Press Inc., New York, 1961. $32.00.

Careers in Astronautics and Rocketry. Training and Opportunities in the Space and Missile Fields. By Carsbie C. Adams and Wernher von Braun in collaboration with Frederick I. Ordway, III. 252 pp. McGraw-Hill Book Co., Inc., New York, 1962. $6.95.

Stereochemistry of Carbon Compounds. By Ernest L. Eliel. 486 pp. McGraw-Hill Book Co., Inc., New York, 1962. $15.00.

An Introduction to the Theory of Newtonian Attraction (reprint of 1940 ed.). By A. S. Ramsey. 184 pp. Cambridge U. Press, New York, 1961. Paperbound $1.75.

Advances in Astronomy and Astrophysics, Volume 1. Zdeněk Kopal, ed. 366 pp. Academic Press Inc., New York, 1962. $10.00.

Fundamental Problems in Statistical Mechanics. Proc. NUFFIC Internat'l Summer Course (Netherlands, Aug. 1961). Compiled by E. G. D. Cohen. 249 pp. (North-Holland, Amsterdam) Interscience, division of John Wiley & Sons, Inc., New York, 1962. $7.50.

Science and the Humanities. By Moody E. Prior. 124 pp. Northwestern U. Press, Evanston, Ill., 1962. $3.50.

Problèmes d'Electronique. A l'Usage des Ingénieurs et Chercheurs, des Etudiants des Facultés et des grandes Ecoles. By Robert Guillien. 418 pp. Eyrolles, Paris, 1962. 77.70 NF.

Theoretical Physics. By Gerhard A. Blass. 451 pp. Appleton-Century-Crofts, Inc., New York, 1962. $8.50.

Solid State Physics, Volume 13. Advances in Research and Applications. Frederick Seitz and David Turnbull, eds. 482 pp. Academic Press Inc., New York, 1962. $14.50.

Analytical Mechanics. By Grant R. Fowles. 278 pp. Holt, Rinehart and Winston, Inc., New York, 1962. $6.00.

Bibliography of the Ionosphere. An Annotated Survey Through 1960. By Laurence A. Manning. 613 pp. Stanford U. Press, Stanford, 1962. $15.00.

Thermophysics. By Allen L. King. 369 pp. W. H. Freeman & Co., San Francisco, 1962. $9.50.

Unpublished Scientific Papers of Isaac Newton. Edited and Transl. by A. Rupert Hall and Marie Boas Hall. 416 pp. Cambridge U. Press, New York, 1962. $11.00.

Mathematics Manual. Methods and Principles of the Various Branches of Mathematics for Reference, Problem Solving, and Review. By Frederick S. Merritt. 378 pp. McGraw-Hill Book Co., Inc., New York, 1962. $9.50.

Modern College Physics. By Harvey E. White. 755 pp. D. Van Nostrand Co., Inc., New York, 1962. $9.75.

Detonation and Two-Phase Flow. S. S. Penner and F. A. Williams, eds. Volume 6 of Progress in Astronautics and Rocketry, edited by Martin Summerfield. 368 pp. Academic Press Inc., New York, 1962. $5.25.